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(54) **TURBO PURGE MODULE HOSE DETECTION AND BLOW OFF PREVENTION CHECK VALVE**

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CPC ***F02M 25/0872*** (2013.01); ***F02M 25/0836*** (2013.01)

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See application file for complete search history.

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(57) **ABSTRACT**

A valve assembly used as part of a vapor purge system, which uses a vacuum created by a venturi nozzle to direct purge vapor from a canister through the purge system, and into an intake manifold. The valve assembly includes a check valve which closes the flow path to prevent the uncontrolled venting of hydrocarbon rich purge vapor directly to the atmosphere, and provides an on-board diagnostic (OBD) check to make sure the system is functioning properly. The check valve is typically open because of a pressure balance around the check valve, allowing the turbo bleed flow, as well as the purge vapor, to pass through the check valve and into an air box. If the hose is disconnected, there is a pressure drop across the valve, which causes the check valve to close, preventing the release of hydrocarbons in the purge vapor to the atmosphere.

20 Claims, 1 Drawing Sheet

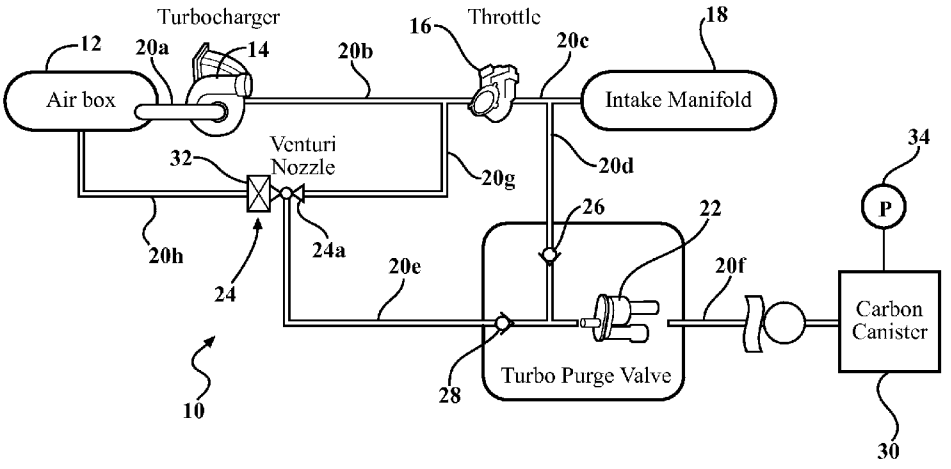

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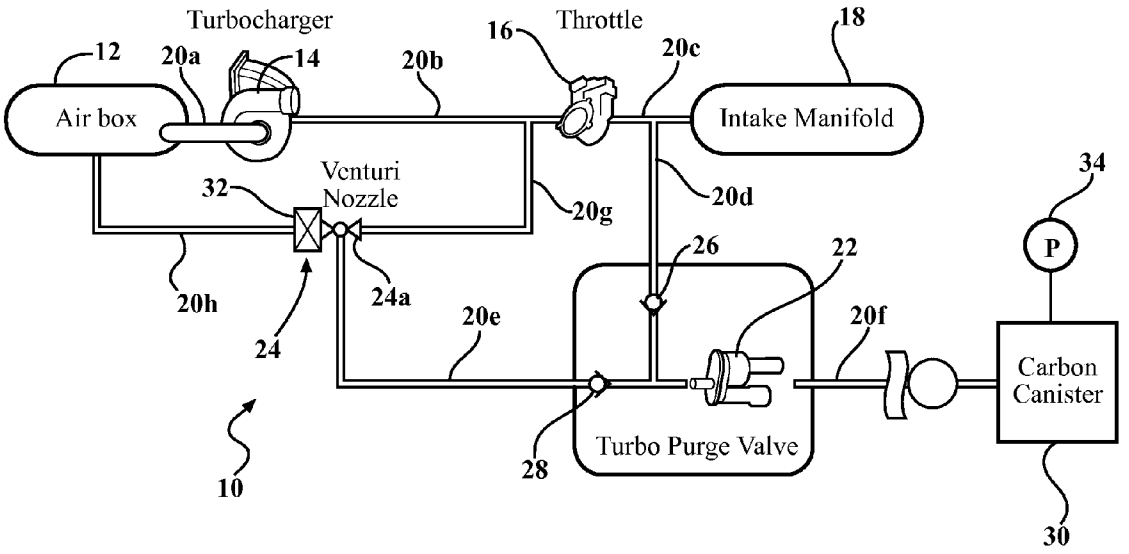
FIG. 1


Turbocharger
Throttle
12
20a
14
20b
16
20c
18
Air box
Intake Manifold
Venturi Nozzle
32
20g
20d
34
P
26
22
20h
24a
20e
20f
24
Carbon Canister
Turbo Purge Valve
28
10
30

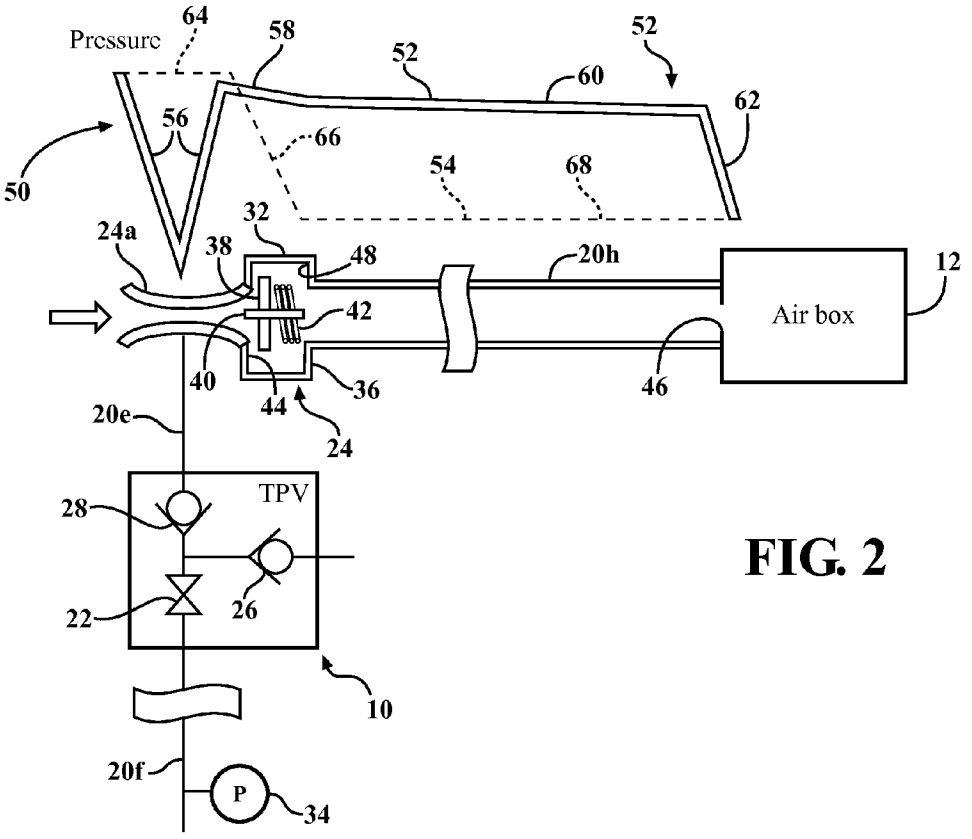

Pressure
64
58
52
52
60
62
56
66
54
68
50
32
24a
38
48
20h
12
42
Air box
40
36
46
44
20e
24
TPV
28
22
26
10
20f
P
34

FIG. 2

TURBO PURGE MODULE HOSE DETECTION AND BLOW OFF PREVENTION CHECK VALVE

FIELD OF THE INVENTION

The invention relates generally to an on-board diagnostic feature in an air flow system of a vehicle which also prevents the undesired release of fuel vapors into the atmosphere.

BACKGROUND OF THE INVENTION

Turbochargers are commonly used to increase the power of a vehicle engine. Turbochargers include a turbine which generates pressurized air, and the air is forced into the engine to increase combustion pressure, and therefore increase the power generated by the engine.

With some tubocharging systems, a portion of the pressurized air is bled off to create a vacuum and induce the flow of purge vapor. The vacuum created is used as part of a purge system, where the purge system directs purge vapors from a fuel tank through various conduits to redirect the vapors into the intake manifold of the engine, and burn off these vapors through combustion.

Some turbo purge systems use a venturi vacuum generator (such as a vacuum pump) to allow purge of the evaporative system while the turbocharger is activated (i.e., the intake manifold is under positive pressure). In typical systems, some of the pressure created by the turbo is bled off, through a venturi, which creates the vacuum needed in the venturi to induce purge vapor flow. These venturi nozzles typically are connected to the air intake box through the use of a hose, through which flows the turbo bleed flow, and the hydrocarbon rich, purge vapor. If this hose becomes detached from the air intake box, this could result in blowing hydrocarbons into the atmosphere under the hood of the car.

There are a number of systems currently in production that are potentially non-compliance in terms of having the ability to be able to detect a hose-off condition. Attempts have been made to address this issue by putting the entire vacuum generating venturi into the air box. Other solutions have included adding pressure transducers to the line. Both of these approaches involve additional cost, and may not completely solve the problem.

Accordingly, there exists a need for the prevention of the release of hydrocarbon rich purge vapor in an air flow system when one of the hoses becomes disconnected.

SUMMARY OF THE INVENTION

The present invention is a valve assembly used as part of a vapor purge system, which uses a vacuum created by a venturi nozzle to direct purge vapor from a canister through the purge system, and into an intake manifold. The valve assembly includes a check valve which closes the flow path to prevent the uncontrolled venting of hydrocarbon rich purge vapor directly to the atmosphere, and provides an on-board diagnostic (OBD) check to make sure the system is functioning properly.

During typical operation, the check valve is normally open because of a pressure balance around the check valve, allowing the turbo bleed flow, as well as the purge vapor, to pass through the check valve and into the air box. If the hose is not connected, there is a pressure drop across the valve, and the drop in pressure causes the check valve to close, preventing the venting of hydrocarbons in the purge vapor to the atmosphere. The restricted turbo bleed flow no longer creates a vacuum, and when a purge cycle is commanded, the pressure transducer on the tank then detects that no purge is occurring, indicating a malfunction. This is used to set a malfunctioning light, to indicate that there is a problem.

The valve assembly of the present invention allows the purge valve and vacuum venturi to be modularized. This eliminates hoses, improves packaging, and reduces system costs.

Under normal operation, the check valve has a default position, which is an open position, allowing the turbo bleed flow and the purge flow to flow through the check valve and into the hose connecting the check valve to the air box of an engine. There is an orifice, or flow restricting nozzle added to the air box inlet. If the hose connecting the check valve to the air box is disconnected, the change in the pressure drop causes the check valve to close. This stops the turbo bleed flow, and the venturi nozzle no longer provides a vacuum differential to induce purge flow. If the purge valve opens, and a purge is expected, the pressure transducer on the purge line does not detect a drop in pressure, indicating that there is an issue, and a malfunction light may be activated to alert the driver of the vehicle that something is malfunctioning. The check valve therefore prevents an uncontrolled release of hydrocarbon rich air to the atmosphere, and provides an OBD diagnostic test to allow for a validation of the functionality of the system.

In one embodiment, the present invention is a valve assembly which includes a venturi valve member, a check valve connected to the venturi valve member, an air box, and a first conduit in fluid communication with and connected to the air box. A housing is part of the check valve, where the housing is connected to and in fluid communication with the first conduit and the venturi valve member, and a second conduit is also connected to and in fluid communication with the venturi valve member. A valve plate is moveably disposed in the housing, and the valve plate is moveable between a plurality of closed positions and an open position.

A flow restricting nozzle is formed as part of the air box, and in a first mode of operation, pressurized air flows from the venturi valve member through the housing of the check valve, applying pressure to the valve plate such that the valve plate moves to an open position, allowing the pressurized air to flow through the check valve. The check valve remains in the open position because of a pressure balance around the valve plate created by the back pressure generated by the flow restricting nozzle. When the first conduit becomes disconnected from the air box, the pressure balance around the valve plate is removed, and the pressurized air flowing from the venturi nozzle flows into the housing and places the check valve in one of the closed positions, preventing air from flowing into the first conduit.

The valve assembly also includes a second mode of operation, in which a vacuum from the air box draws air through the venturi valve member and the housing of the check valve, placing the valve plate in an open position. In the second mode of operation, if the first conduit becomes disconnected from the air box, the venturi valve member and valve plate are no longer exposed to the vacuum from the air box, and the check valve moves to one of the closed positions.

There is a pressure drop across the venturi valve member during the first mode of operation and the second mode of operation, which creates a vacuum in the second conduit, drawing purge vapor from the second conduit into the venturi valve assembly.

A first inner surface is formed as part of the housing, and a second inner surface formed as part of the housing on the opposite side of the housing in relation to the first inner

surface. A guide is located in the housing between the first inner surface and the second inner surface, and the valve plate is slidably mounted on the guide. A spring is located in between and in contact with the valve plate and the second inner surface, such that the spring biases the valve plate toward the first inner surface. During the first mode of operation, the pressurized air applies pressure to the valve plate in the opposite direction of the force applied to the valve plate from the spring, overcoming the force of the spring, such that the valve plate moves to the open position. The pressure balance provided by the flow restricting nozzle maintains the valve plate in the open position.

During the second mode of operation, the vacuum from the air box draws the valve plate toward the second inner surface, overcoming the force of the spring, and places the valve plate in the open position.

Further areas of applicability of the present invention will become apparent from the detailed description provided hereinafter. It should be understood that the detailed description and specific examples, while indicating the preferred embodiment of the invention, are intended for purposes of illustration only and are not intended to limit the scope of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will become more fully understood from the detailed description and the accompanying drawings, wherein:

FIG. **1** is a first diagram of an airflow system for a vehicle having a venturi valve assembly, according to embodiments of the present invention; and

FIG. **2** is a diagram showing the correlation between a pressure chart and part of an airflow system for a vehicle having a venturi valve assembly, according to embodiments of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The following description of the preferred embodiment(s) is merely exemplary in nature and is in no way intended to limit the invention, its application, or uses.

A diagram of an airflow system of a vehicle having a turbo purge valve assembly according to the present invention is shown generally in FIG. **1** at **10**. The system **10** includes an air box **12** which intakes air from the atmosphere. Located downstream of and in fluid communication with the air box **12** is a turbocharger unit **14**, and located downstream of and in fluid communication with the turbocharger unit **14** is a throttle assembly **16**. The throttle assembly **16** controls the amount of air flow into an intake manifold **18**, which is part of an engine.

A plurality of conduits also provides fluid communication between the various components. Air flows through the conduits between the various components, and the direction of airflow through the conduits varies, depending on the mode of operation of each component. More specifically, there is a first conduit **20***a* providing fluid communication between the air box **12** and the turbocharger **14**, a second conduit **20***b* providing fluid communication between the turbocharger **14** and the throttle assembly **16**, and there is also a third conduit **20***c* providing fluid communication between the throttle assembly **16** and the intake manifold **18**.

A fourth conduit **20***d* is in fluid communication with the third conduit **20***c* and a fifth conduit **20***e*, and the fifth conduit **20***e* places a turbo purge valve **22** in fluid communication with a venturi valve assembly **24**. There is a first check valve **26** disposed in the fourth conduit **20***d*, and a second check valve **28** disposed in the fifth conduit **20***e*. There is also a carbon canister **30** in fluid communication with the turbo purge valve **22** through the use of a sixth conduit **20***f*.

A seventh conduit **20***g* provides fluid communication between the venturi valve assembly **24** and the second conduit **20***b*, such that pressurized air produced by the turbocharger **14** is able to flow from the second conduit **20***b*, through the seventh conduit **20***g* and to the venturi valve assembly **24**. An eighth conduit **20***h* provides fluid communication between the venturi valve assembly **24** and the air box **12**. The venturi valve assembly **24** includes venturi valve member **24***a* shown in FIG. **1** and a check valve **32**, which is connected to the eighth conduit **20***h*.

Referring to the Figures generally, in operation, when the turbocharger **14** is not active, air flows through the air box **12**, the turbocharger **14**, the throttle **16**, and into the intake manifold **18**. The engine creates a vacuum drawing air into the intake manifold **18**. This vacuum also causes the first check valve **26** to open, which draws purge vapor from the canister **30** through the turbo purge valve **22** (when the valve **22** is open), and into the intake manifold **18**. This same vacuum pressure also causes the second check valve **28** to close.

When the turbocharger **14** is activated, air flowing into the turbocharger **14** from the air box **12** is pressurized, the pressurized air flows through the throttle **16**, and the air then flows into the intake manifold **18**. In this mode of operation, the manifold **18** is operating under positive pressure.

When the turbocharger **14** is activated, and pressurized air is passing through the seventh conduit **20***g*, the venturi valve member **24***a*, the check valve **32** (when the check valve **32** is in an open position), and the eighth conduit **20***h*, a vacuum is created and air is drawn from the fifth conduit **20***e* through venturi valve assembly **24**, such that the air passes through the eighth conduit **20***h* and into the air box **12**. This vacuum in the fifth conduit **20***e* also opens the second check valve **28**, and purge vapor from the canister **30** passes through the turbo purge valve **22** (when the valve **22** is open), through the venturi valve **24***a*, the check valve **32**, and into the air box **12**. The purge vapor then flows through the turbocharger **14**, the throttle **16**, and into the intake manifold **18**.

The check valve **32** includes a housing **36**, where the venturi valve **24***a* is connected to the housing **36**, and the eighth conduit **20***h* is also connected to the housing **36**. Disposed in the housing **36** is also a valve plate **38** mounted on a guide **40**. Also located within the housing **36** and at least partially surrounding the guide **40** is a biasing member, which in this embodiment is a spring **42**. The spring **42** biases the valve plate **38** towards the venturi valve member **24***a* such that when air is not passing through the venturi valve member **24***a*, the spring **42** applies enough force to the valve plate **38** that the valve plate **38** contacts a first inner surface **44** of the housing **36**, placing the valve **32** in a closed position.

There is a flow restricting nozzle **46** formed as part of the air box **12**, as shown in FIG. **2**. When the turbocharger **14** is generating pressurized air, the pressure from the air flow overcomes the force applied to the valve plate **38** by the spring **42**, moving the valve plate **38** away from the first inner surface **44**, and towards a second inner surface **48**. The spring **42** is also in contact with the second inner surface **48** and the valve plate **38**. The flow restricting nozzle **46** limits the amount of flow of air into the air box **12** from the eighth conduit **20***h*, allowing pressure to build in the eighth conduit **20***h*, creating a backpressure, which therefore creates a pressure balance around both sides of the valve plate **38**. This pressure balance around the valve plate **38**, along with the force applied to the valve plate **38** by the spring **42**, maintains the valve plate **38** in an open position.

The valve plate **38** is considered to be in the open position when the valve plate **38** is not in contact with either the first inner surface **44** or the second inner surface **48**, regardless of how close the valve plate **38** is to either surface **44**, **48**, because air is allowed to flow from the venturi valve member **24***a* and around the valve plate **38** in the housing **36** and into the eighth conduit **20***f*, even if there is a relatively small gap between the valve plate **38** and either of the surfaces **44**, **48**. The location of the valve plate **38** changes because the operation of the engine varies the level of pressurized air generated by the turbocharger **14** during the first mode of operation, and varies the level of vacuum from the air box **12** during the second mode of operation. This varies the air flow around the valve plate **38** in the housing **36**.

The valve **32** also includes an automatic closing feature if the eighth conduit **20***h* were to ever become disconnected from the air box **12**. The valve **32** has multiple closed positions, and in one of the closed positions, the valve plate **38** is in contact with the first inner surface **44**, and in another of the closed positions, the valve plate **38** is in contact with the second inner surface **46**. If the eighth conduit **20***h* is disconnected from the air box **12**, due to the conduit **20***h* breaking or the like, the flow restricting nozzle **46** no longer functions to limit the air flow through the conduit **20***h*, thereby eliminating the back pressure and therefore the pressure balance around the valve plate **38**. Under this condition, the pressurized air from the turbocharger **14** flowing through the venturi valve member **24***a* applies enough pressure to the valve plate **38** to overcome the force of the spring **42**, moving the valve plate **38** away from the venturi valve member **24***a* and toward the second inner surface **48** such that the valve plate **38** contacts the second inner surface **48**, placing the check valve **32** in a closed position.

This automatic closing feature provides several features. One of which is an on-board diagnostic (OBD) function, and another is the prevention of vapor from the canister **30** from entering into the atmosphere. When the turbocharger **14** is generating pressurized air, and purge vapor is passing through the purge valve **22**, some level of vacuum should be detectable in the canister **30** by a pressure sensor **34**. If the check valve **32** is closed because of the detachment of the eighth conduit **20***h* from the air box **12**, the air in the eighth conduit **20***h* and the seventh conduit **20***g* remains pressurized, but because there is no air flow, the vacuum pressure in the fifth conduit **20***e* is eliminated, and the second check valve **28** moves to a closed position. If the turbocharger **14** is generating pressurized air, and the purge valve **22** is open, but there is no vacuum pressure in the fifth conduit **20***e* to open the second check valve **28** and allow the vapors from the canister **30** to flow through the valve **22**, the pressure sensor **34** detects no pressure change in the canister **30**, indicating that the system **10** has a malfunction. Also, because the check valve **32** is closed, the vapors (hydrocarbon rich air) in the canister **30** are prevented from venting to the atmosphere.

This is also shown in the chart, shown generally at **50** in FIG. **2**, where the first line **52** indicates different pressure levels along the venturi valve member **24***a*, the check valve **32**, and the eighth conduit **20***h*, when the eighth conduit **20***h* is connected to the air box **12**. The chart **50** also includes a second line **54** which indicates different pressure levels along the venturi valve member **24***a*, the check valve **32**, and the eighth conduit **20***h*, when the eighth conduit **20***h* is disconnected from the air box **12**.

The first line **52** has a first zone **56** which shows the pressure drop across the venturi valve member **24***a*. A portion of this zone **56** has negative pressure, which indicates the vacuum pressure used to draw the purge vapor into the venturi valve assembly **24** from the fifth conduit **20***e*. The first line **52** also has a second zone **58**, which shows the small difference in pressure on each side of the valve plate **38**, and when the force of the spring **42** is combined with the air pressure on each side of the valve plate **38**, the above-mentioned pressure balance on each side of the valve plate **38** is achieved, maintaining the valve plate **38** in the open position, as shown in FIG. **2**. The first line **52** also includes a third zone **60**, which shows a small pressure drop through the eighth conduit **20***h*, and a fourth zone **62** which shows the pressure drop to zero pressure once the air reaches the air box **12** after passing through the flow restricting nozzle **46**.

The second line **54** has three zones, the first zone **64** which indicates the pressure along the venturi valve member **24***a*, a second zone **66** showing the pressure drop across the check valve **32**, and a third zone **68** indicating little or no pressure in the eighth conduit **20***h*. The three zones **64**, **66**, **68** of the second line **54** indicate the pressure levels when the eighth conduit **20***h* is disconnected from the air box **12**, and the check valve **32** is in a closed position. This pressure level in the first zone **64** is constant, because the check valve **32** is in a closed position, and the valve plate **38** is in contact with the second inner surface **48**. The second zone **66** shows the pressure change across the check valve **32**, where one side of the valve plate **38** is exposed to the pressurized air generated by the turbocharger **14** flowing through the venturi valve member **24***a*, and the other side of the valve plate **38** receives force from the spring **42**, but because there is no pressure in the eighth conduit **20***h* (due to the eighth conduit **20***h* being detached from the air box **12**), there is little to no pressure on the other side of the valve plate **38**, as indicated by the decrease in the second line **54** in the second zone **66**. The third zone **68** of the second line **54** indicates little or no pressure in the eighth conduit **20***h*; this occurs because the eighth conduit **20***h* being disconnected from the air box **12**, and therefore the flow restricting nozzle **46** doesn't provide flow restriction of the pressurized air, producing little to no pressure in the eighth conduit **20***h*.

The description of the invention is merely exemplary in nature and, thus, variations that do not depart from the gist of the invention are intended to be within the scope of the invention. Such variations are not to be regarded as a departure from the spirit and scope of the invention.

What is claimed is:

1. An apparatus, comprising:

a valve assembly, including:

a venturi valve member;

a valve connected to the venturi valve member, the valve being movable between an open position, and one of a plurality of closed positions;

an air box; and

a first conduit in fluid communication with and connected to the valve and the air box;

wherein the venturi valve member and the valve function in at least two modes of operation, such that in the first mode of operation, pressurized air flows from the venturi valve member and through the valve, the first conduit, and into the air box, and the valve is exposed to back pressure such that the valve is placed in the open position, and in a second mode of operation, vacuum draws air from the valve and the venturi member, placing the valve in the open position, allowing the air to pass through the first conduit and into the air box, and during the second mode of operation, the valve changes to one of the plurality of closed posi-

tions when the first conduit becomes detached from the air box, and the valve is no longer exposed to the vacuum.

2. The apparatus of claim 1, the valve being a check valve, further comprising:

a housing connected to the venturi valve member, the first conduit connected to the housing;

a valve plate disposed in the housing, the valve plate moveable between the open position and one of the plurality of closed positions; and

a spring connected to the valve plate and the housing such that the spring biases the valve plate towards the venturi valve member;

wherein during the first mode of operation, the pressurized air flows through the venturi valve member into the housing, and applies pressure to the valve plate such that the force applied to the valve plate from the spring is overcome, and a back pressure is generated in the first conduit and applied to the valve plate such that a pressure balance around the valve plate is achieved, maintaining the check valve in the open position.

3. The apparatus of claim 2, wherein during the first mode of operation, and the first conduit is detached from the air box, the back pressure is removed from the valve plate, and the pressurized air applies force to the valve plate, and the check valve changes to one of the plurality of closed positions.

4. The valve assembly for an air flow system of claim 2, wherein during the second mode of operation, a vacuum from the air box draws air through the venturi valve member and the check valve, placing the check valve in the open position such that if the first conduit becomes disconnected from the air box, the venturi valve member and check valve are no longer exposed to the vacuum from the air box, and the check valve moves to one of the plurality of closed positions.

5. The apparatus of claim 2, further comprising:

a first inner surface formed as part of the housing;

a second inner surface formed as part of the housing; and

a guide located in the housing between the first inner surface and the second inner surface, the valve plate being slidably mounted on the guide;

wherein the spring biases the valve plate toward the first inner surface, and in the first mode of operation, the pressurized air applies force to the valve plate to overcome the force applied to the valve plate by the spring, placing the check valve in the open position, and in the second mode of operation, the vacuum overcomes the force applied to the valve plate by the spring, placing the check valve in the open position.

6. The apparatus of claim 5, wherein during the first mode of operation and the first conduit becomes detached from the air box, the pressurized air in the check valve applies pressure to the valve plate such that the force of the spring is overcome, and the valve plate moves towards and contacts the second inner surface, placing the check valve in one of the plurality of closed positions.

7. The apparatus of claim 5, wherein during the second mode of operation, and the first conduit becomes detached from the air box, the vacuum is removed from the check valve and the venturi valve member, and the force from the spring moves the valve plate toward and contacts the first inner surface, placing the check valve in one of the plurality of closed positions.

8. The apparatus of claim 1, further comprising:

a flow restricting nozzle formed as part of the air box;

wherein the flow restricting nozzle generates the back pressure in the first conduit and the valve such that when the first conduit is detached from the air box, and the valve assembly is in the first mode of operation, the pressure balance in the valve is removed, and the valve changes from the open position to one of the plurality of closed positions.

9. The apparatus of claim 1, further comprising a second conduit connected to the venturi valve member such that purge vapor is drawn from the second conduit into the venturi valve member and mixed with the pressurized air in the first mode of operation, and in the second mode of operation the vacuum drawing air from the venturi valve assembly draws the purge vapor from the second conduit into the venturi valve member such that the purge vapor is mixed with the air in the venturi valve member.

10. The valve assembly of claim 9, further comprising a pressure drop across the venturi valve member during the first mode of operation and the second mode of operation, wherein the pressure drop across the venturi valve member creates a vacuum in the second conduit, drawing purge vapor from the second conduit into the venturi valve assembly.

11. A valve assembly for an air flow system having multiple modes of operation, comprising:

a venturi valve member;

a check valve connected to the venturi valve member;

an air box;

a first conduit in fluid communication with and connected to the check valve and the air box;

a flow restricting nozzle formed as part of the air box; and

a second conduit in fluid communication with the venturi valve member;

wherein in a first mode of operation, pressurized air flows from the venturi valve member through the check valve, placing the check valve in an open position, allowing the pressurized air to flow through the check valve, and the check valve remains in the open position because of a pressure balance around the check valve created by the back pressure generated by the flow restricting nozzle such that when the first conduit becomes disconnected from the air box, the pressure balance around the check valve is removed, and the pressurized air flowing from the venturi nozzle flows into the check valve and places the check valve in one of a plurality of closed positions, preventing air from flowing into the first conduit.

12. The valve assembly for an air flow system of claim 11, further comprising a second mode of operation, where a vacuum from the air box draws air through the venturi valve member and the check valve, placing the check valve in the open position such that if the first conduit becomes disconnected from the air box, the venturi valve member and check valve are no longer exposed to the vacuum from the air box, and the check valve moves to one of the plurality of closed positions.

13. The valve assembly for an air flow system of claim 11, the check valve further comprising:

a housing connected to the venturi valve member;

a first inner surface formed as part of the housing;

a second inner surface formed as part of the housing;

a guide located in the housing between the first inner surface and the second inner surface;

a valve plate slidably mounted on the guide; and

a spring connected to the valve plate, such that the spring is located between the valve plate and the second inner surface;

wherein during the first mode of operation, the pressurized air applies pressure to the valve plate, overcoming the force of the spring, such that the valve plate moves to the open position, and the pressure balance provided by the flow restricting nozzle maintains the valve plate in the

open position, and during the second mode of operation, the vacuum from the air box draws the valve plate toward the second inner surface, overcoming the force of the spring, and places the valve plate in the open position.

14. The valve assembly of claim **13**, wherein during the first mode of operation, and the first conduit becomes disconnected from the air box, the pressure balance provided by the flow restricting nozzle is removed, and the pressurized air flowing from the venturi valve member applies pressure to the valve plate, overcoming the force applied to the valve plate by the spring, placing the valve plate in contact with the second inner surface such that the check valve is in one of the plurality of closed positions.

15. The valve assembly of claim **13**, wherein during the second mode of operation, and the first conduit becomes disconnected from the air box, the vacuum pressure in the venturi valve member and the check valve is removed, and the spring moves the valve plate such that the valve plate contacts the first inner surface, placing the check valve in one of the plurality of closed positions.

16. The valve assembly of claim **11**, further comprising a pressure drop across the venturi valve member during the first mode of operation and the second mode of operation, the pressure drop across the venturi valve member creates a vacuum in the second conduit, drawing purge vapor from the second conduit into the venturi valve assembly.

17. A valve assembly, comprising:

a venturi valve member;

a check valve connected to the venturi valve member;

an air box;

a first conduit in fluid communication with and connected to the air box;

a housing being part of the check valve, the housing connected to and in fluid communication with the first conduit and the venturi valve member;

a valve plate moveably disposed in the housing, the valve plate moveable between at least one closed position and an open position;

a flow restricting nozzle formed as part of the air box; and

a second conduit in fluid communication with the venturi valve member;

wherein in a first mode of operation, pressurized air flows from the venturi valve member through the housing of the check valve, applying pressure to the valve place such that the valve plate moves to the open position, allowing the pressurized air to flow through the check valve, and the check valve remains in the open position because of a pressure balance around the valve plate created by the back pressure generated by the flow restricting nozzle such that when the first conduit becomes disconnected from the air box, the pressure balance around the valve plate is removed, and the pressurized air flowing from the venturi nozzle flows into the housing and places the check valve in the at least one closed position, preventing air from flowing into the first conduit.

18. The valve assembly of claim **17**, further comprising a second mode of operation, vacuum from the air box draws air through the venturi valve member and the housing of the check valve, placing the valve plate in the open position such that if the first conduit becomes disconnected from the air box, the venturi valve member and valve plate are no longer exposed to the vacuum from the air box, and the check valve moves to the at least one closed position.

19. The valve assembly of claim **17**, further comprising:

a first inner surface formed as part of the housing;

a second inner surface formed as part of the housing on the opposite side of the housing in relation to the first inner surface;

a guide located in the housing between the first inner surface and the second inner surface, the valve plate slidably mounted on the guide; and

a spring located in between and in contact with the valve plate and the second inner surface, such that the spring biases the valve plate toward the first inner surface;

wherein during the first mode of operation, the pressurized air applies pressure to the valve plate in the opposite direction of the force applied to the valve plate from the spring, overcoming the force of the spring, such that the valve plate moves to the open position, and the pressure balance provided by the flow restricting nozzle maintains the valve plate in the open position, and during the second mode of operation, the vacuum from the air box draws the valve plate toward the second inner surface, overcoming the force of the spring, and places the valve plate in the open position.

20. The valve assembly of claim **17**, further comprising a pressure drop across the venturi valve member during the first mode of operation and the second mode of operation, the pressure drop across the venturi valve member creates a vacuum in the second conduit, drawing purge vapor from the second conduit into the venturi valve assembly.

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